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ABSTRACT

The population explosion and developments in information technology have created a powerful need for technological advancement on a global scale. Such advancement must come through education, and such education, given the size and breadth of the need, is best realized through multimedia instruction and distance education. Communications satellites, computer-assisted instruction, and educational television programs are just a few of the new technologies already being used today for educational development in developing nations. International programming of high quality is used in mathematics, physics, chemistry, and engineering. Computer networks and new fiber optic transmission technology--along with interactive video, artificial intelligence, and other interactive technologies--are emerging in new and creative educational applications. Technology alone, however, will not achieve the goal of technological advancement. Attention must also be paid to curriculum development, local educational environments, technology management, and international cooperation. (DB)

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Technology and Education: Friends or Foes?

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International Conference on Distance Education

Introduction

In the last 2500 years the population of Planet Earth has experienced an explosion. Human inhabitants have increased from 100 million to 5 billion representing a dramatic fifty-fold increase. Yet during this same period, human information has increased from about 10^8 bits of information to about 10^{15} bits of information -- a staggering increase of 10 million times. In short , over the last two and a half millennia, information has expanded 250,000 times faster than human population. While we have recognized the population explosion, we have tended to overlook the fact that information has gone super nova!

The creation of information and access to it is, of course, unequally distributed around our small globe. Through powerful telecommunications and information networks some can call forth virtually every stored fact in the human knowledge base; others do not know the basics of modern agriculture, nutrition and health care. As the twentieth century draws to a close we are seeing new devices with artificial intelligence that can make us "quicker, smarter and exceptionally well informed." These intellectual prosthetic devices are becoming like an extra brain we can carry in our briefcases. Perhaps someday have implanted in the form of a computer

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chip inside our skull. Each new intellectual opportunity carries with it an opportunity and a potential threat to our humanity. Make no mistake about it. Humankind has already made such choices already millennia ago. Written language, books, tape recorders and more are clearly intellectual prosthetics too. The difference is that our new tools of advanced communication satellites, fiber optic cables, fifth generation computers, expert systems, and "intelligent robotics," are creating new levels of technological assistance. Today we have the potential to be taught by machines, aided in our work, prompted when our memories fail us, and generally indulged when our human intellect seems inadequate or faulty.

Our information and telecommunications systems represent both danger and opportunity. We can't hide the fact that global education is in a crisis situation. The world population of some 5 billion people will likely rise to about 10 billion sometime around the middle of the 21st Century. Even today it is estimated by UN studies that 750 million new jobs are needed in developing countries to stay even with population growth trends over the next ten years. Yet, how these jobs will be created and whether conventional approaches to creating economic growth can meet the challenge is not at all clear. Everywhere, then, there are new and growing demands on education. In the developed world there is the need for education with flexibility to adapt to a new technological environment that is always changing. There is likewise a need for lifelong education as multiple careers become commonplace. Further the Organization of Economic Cooperation and Development (OECD) countries, particularly the U.S., must develop educational curricula and strategies that counteract the destructive effect of television and electronic games.

Although the educational needs of developing countries are far different they are still every bit as demanding. In many developing countries population growth rates are above 5% and the result is often a median national age of 17 or 18 years. This means a huge infant and child population which requires health care and education and a relatively small adult population producing the economic wealth to pay for social services. It can become a vicious circle. With billions of children to educate and limited human and financial resources in the developing world with which to respond, the use of new electronic technology seems not only appropriate but essential. Likewise in the developed world various new educational media seem the only way to provide effective, flexible and lifelong educational services. But what about the dangers?

There are many concerns about "mediated education." The most common concern is global homogeneity. Certain facts are clear. English is the predominant language of tele-education, computer assisted instruction, and so on, even though French and Spanish are also greatly used. Much of the software for video instructional materials are produced in the U.S., with most of the rest being produced in Europe, Canada and Japan, although India, Indonesia, Mexico and Egypt make important contributions. Some traditional cultures feel under assault by Hollywood movies, video games and outside programming from satellite TV broadcasts.

There are two extreme views of global education and culture. One is that of an "anthropological zoo" where enormous efforts are believed necessary to preserve cultural, social, economic, and linguistic diversity. In this view of humanity, "different" is not only better but sacred. Each cultural or linguistic loss is a sin.

The second human cultural model is the opposite extreme. Humans are seen as riding on a six sextillion ton mudball, revolving around a minor star that inhabits the outback of a run-of-the-mill galaxy. In this model we are common passengers on spaceship Earth. We are seen as more successful as we become more united and integrated. If we are working to a common purpose, then the better the species will be able to respond to the challenges of the cosmos.

Who's right and who's wrong? My answer is neither. A balanced approach in between these extremes probably makes the best sense. The evolving nature of human technology, however, almost invariably brings us closer to the global mudball view of our planetary culture. Tele-education, robotic teaching devices, interactive video disc and computer aided instruction, just like television and radio before them, bring us together but almost always diminish and limit diversity rather than expand it. Unless...unless we are sensitive to the problem and seek to minimize these effects.

It is for these reasons and more that many fear the new electronic technologies. Technology can be frightening in its own right, but here we are talking about concerns about standardization of thought, of erosion of cultural and linguistic purity, technological unemployment and obsolescence and potentially even mega-training techniques. Only the disingenuous or the naive will say that tele-education techniques do not harbor these dangers.

Even so, in light of the tremendous needs of both the developed and developing world, tele-education may be the only means for long term human survival. If humanity is to realize its destiny of traveling to the stars and perhaps evolving toward a higher intellect, it seems likely that

tele-education may be central to overcoming today's obstacles and to achieving tomorrow's goals.

How can we realize the potential of our new knowledge-based technologies and to avoid the pitfalls of these electronic techniques? Not easily. The answer seems to be: with caution; with educational, linguistic and national diversity; and an institutional commitment to excellence and international cooperation. When one begins a systematic review of the many fine initiatives that have already begun to extend the benefits of tele-education to every corner of the globe, there is at once hope and a caution signal.

There are already many excellent initiatives to create global and regional tele-education linkages. These include the University of the World; the Global (Pacific) Electronic University; the Foundation for International Tele-Education (FIT); the International Space University, and Educational Broadcast Services Trust, Ltd. of the U.K.; the University of the South Pacific; the Tele-Universite of Montreal; the International University Consortium; the Knowledge Network of the West (KNOW of Vancouver, Canada) and the Commonwealth of Learning of the British Commonwealth, among others. In addition to these ongoing initiatives there was the global tele-education experiment sponsored by INTELSAT and the International Institute of Communications (IIC). These tests conducted under the name of SHARE (Satellite for Health and Rural Education) from 1984 to 1987 included several dozen tele-health and tele-education events involving 68 countries. These tests were preceded by the U.S. NASA Application Technology Satellite (ATS) tests, the French-German Symphonie tests and the U.S. AID educational tests in Peru (using INTELSAT). and in Indonesia (using Palapa). From these tests and more

it is now clearly known that the technology works but that the software and the human resource coordination often don't produce the desired results.

It is also known that one-time short term tele-education events can be highly successful but that global tele-education initiatives are subject to serious problems such as inconsistent funding and lack of major endowments, a lack of a firm institutional basis, an absence of quality programing well suited to local needs and cultural background, and no depth in staffing and management. Further, when introduced to many developing countries, there is the suspicion that this is a foreign concept and technology. This suspicion is heightened by the recognition that in over 50% of the cases it is an American planned, programmed or funded initiative. There is otherwise no particular reason why this should be the case since the expertise can be found around the globe.

It should come as no surprise that the most successful tele-education initiatives are at the national or even "local" level. Hundreds of national tele-education programs exist around the world. The Open University under BBC auspices in the U.K., the Tele-Kolleg in the Federal Republic of Germany and the National TV University of China are only some of the more prominent examples. In the U.S. alone, there is the National University Teleconference Network (NUTN), the National Technological University (NTU), CATECS of the University of Colorado, California State University at Chico, the 4 "Star Schools" consortia, and over a dozen state educational networks some of which are satellite based and others which are fiber optic based. Currently, the commercially based T1-IN network provides educational programming to public schools in over half of the states in the U.S. In short, electronic based tele-education is not only well established but in fact a multi-billion dollar enterprise.

Today about 50% of the students in the rural parts of the U.S. receive intensive video education supplements to their eduction, particularly in advanced curricula such as chemistry, physics, foreign languages, etc. Most of the 50 states have some such programs. By 2010 over 50% of all educational instruction in the U.S.will be "mediated education" according to a UCLA study. The reasons for this projected growth are clear-cut. Tele-education or mediated education:

- Compensates for a deficiency in the numbers of qualified teachers.
- Is a more cost-efficient mode of operation.
- Provides flexible programming on difficult, demanding and rigorous subjects of a specialized nature where and when needed -- especially in remote areas.
- Provides very high quality educational services on an up to date basis. (On a conventional basis this would be prohibitively expensive.)

If these trends are indicative of education in the twenty-first century, then what might this tell us of the future? A number of futurists such as Alvin Toffler, James Naisbitt, Ted Roszak, Arthur Clarke, Jacques Ellul, Marshall McLuhan and Kurt Vonnegut, Jr., have predicted a future strangely shaped by new technology. Interestingly, these futurists are dramatically different in their future views. Roszak and Vonnegut, for instance, paint a rather dark picture of technology out of scale with human needs. They envision a time when few humans have meaningful jobs or finely educated minds. Others such as Naisbitt and Toffler portray a technology that pours forth a cornucopia of prosperity, custom gadgets and

gizmos and affords us greater opportunities for education and culture. My own view as expressed in my books Global Talk and its sequel Future Talk is that technology is clearly a two-edged sword that can cut both ways. Advanced telecommunications and information systems promise globalism, increased wealth, "super speed" activity, large scale activities and megacorporations, more sophisticated weaponry and the 168 hour work week. This telepower driven system can unfortunately cause information overload, increased vulnerability to terrorism, invasion of privacy, and job loss through both technological unemployment and "electronic immigration".

The real question is what truly socially purposeful thing can this technology do. It is my view that telecommunications, computers and artificial intelligence can be combined to educate and enhance the health of billions of people in the next 50 years. With exceptional luck, the beneficiaries may turn out to be far more in number than all people that have lived on Planet Earth up to this date in human history. This technology may also take us to the planets and the stars and even help evolve a new species that might be called Homo Electronicus. There is enormous hope in the very concept I call tele-education, but to succeed great care and caution is needed. To succeed, such an effort must be globally planned amid a great deal of international cooperation. Tele-education, used in a form of rote-drilling of thousands of "human drones" could become simply megatraining. This could have damaging effects on objective thought processes, and even worse political effects. It is the obligation of everyone at this International Conference on Distance Education to ensure that the right choices concerning tele-education are made. We need to work together to make tele-education a global force for

knowledge, for intellectual enlightenment and global peace and cooperation. This conference can be the beginning of a global education renaissance.

The New Technologies and Education Today

To realize the potential of the new technologies for educational development, it is useful to review where we are today and to consider each of the component parts. I choose to begin with the most important and difficult part -- the content or as some would say, the software. Unfortunately, there are almost endless examples of telecommunications systems that have or can go wrong. Often communications satellite systems are established at a cost of $200 million, $500 million, even a billion dollars where 90% or more of the money is spent on hardware and 10% or less is left for software. When the Indonesian satellite system was deployed, in good part for educational purposes, the satellites were purchased and launched first. Next came the earth stations and some 4 to 5 years later the educational broadcast production center was fully geared up to produce a total of some 5 to 10 hours of programming a week. Clearly the priorities were awry here, but developed countries have not necessarily fared better.

If tele-education is to work in a systematic and effective way, then software needs to be given priority over hardware. Local, national, regional, and even global programming of high quality can be used in a number of areas such as mathematics, physics, chemistry and engineering, but for the social sciences, literature and the arts great care must be taken

with a "global" curriculum. To avoid "homogeneity" and to include local culture.

Extensive experiments as well as operational experience with tele-educational courses have greatly increased our the knowledge base about course content . The following conclusions represent a distillation of many years of experience.

1. Multi-media: Tele-education course content is only a part of an overall whole. Text books, other course materials, tests, research papers and theses are also required. Multimedia is more successful than a single medium cours e.
2. Interactivity: Successful tele-education is almost always interactive with an audio return channel. If students cannot interact with their teacher they often lose interest.
3. Efficiency of Narrow Band Education: Although almost everyone will say that they prefer full motion television, it has been shown many times by the University of the West Indies and University of the South Pacific that an audio channel enhanced by slow-scan television works very well in a wide variety of courses with only a small fraction of the hardware and software costs of a regular video channel.
4. Local Environment/Local Presence: The more successful national tele-education projects have had "local teachers" trained to produce "local" television courses. Furthermore, local teaching aids to reinforce the messages of the video teacher and to monitor the classroom behavior and answer questions which could not be accommodated in the video portion of the course. Local people cannot be eliminated without a negative effect. In short the object

of tele-education is to upgrade quality, insure up-to-date information and to reach a more diverse and distributed audience. Elimination of jobs and saving money is not the main objective and in fact is only an occasional by-product.

5. Cooperation, Partnership and Joint Enterprise: Launching a tele-education project is not easy and is best done on a cooperative basis. A joint agreement, or co-venture with others with experience in the field is highly recommended. A new organization known as the Foundation for International Tele-Education (FIT) has advocated an international clearinghouse to help with such partnerships, and in particular to enhance the quality, international character and effectiveness of programming developed for international use and exchange.
6. Central Importance of Teachers: Good teachers are still key to quality education. It is vital to have the best teachers involved in planning, producing, and delivering course materials. It is also important that teachers, good teachers, be available for interaction with students for "live" questions and answers. Any other approach is almost certain to fail.

One could go on to suggest other guidelines for obtaining good programming for tele-education projects, but these are perhaps among the most important points.

There does remain one further issue deserving special consideration. This basic issue is: how do you ensure you are achieving education in the use of electronic media and how do you avoid providing simply mass training or rote memorization? This is a very serious issue because "electronic training" on a massive scale, what I have dubbed

"megatraining" could be abused for political purposes by a totalitarian state. Unfortunately, there are no easy rules to prevent abuse of tele-education technology. Precautions that can be taken, however, include a high degree of interaction, exercises, tests, and creative or interpretive written presentations. Furthermore, in order to prevent long term political misuse of tele-education techniques to mold public opinion on a mass scale, some forms of legislative controls may also prove necessary. In short, the goal must be to maximize the potential of tele-education while preventing its misuse in various areas such as privacy invasion, mindless megatraining, cultural imperialism or reduction in linguistic diversity.

The New Transmission Technologies

Good programming can now reach greatly expanded audiences even in rural and remote areas. This can be done at low cost, with tremendous flexibility in subject, content, locations served, and choice of narrow or wide band formats. There are two new technologies, namely satellite communications and fiber optic cable, that have dramatically enhanced tele-educational capabilities, but others such as VHF terrestrial radio telephone, cellular radio technology and other new mobile communications techniques are making important contributions. There are several key factors that show where and how satellites and fiber optics are well suited to educational applications.

Table I

Comparing Satellite and Fiber Optics for Tele-Education Applications

Evaluation Criteria	Satellites	Fiber Optics
Ability to Provide Narrow,Medium, or Wideband Capability	Excellent	Excellent
High Quality, Cost Efficient Transmission	Excellent	Excellent
Ability to Serve Rural and Remote Areas & Provide Broadcast Services	Excellent	Limited
Ability to Create Interactive Networks	Excellent	Excellent

As can be seen from Table I, both satellite and fiber optic transmission have great advantages. They have in fact complementary strengths. Satellites are still best for broadcast distributions and for rural and remote access, while fiber optics are well suited for linking centers of learning, university systems, etc. Fiber optic educational networks are well suited to be "piggy-backed" on top of public telecommunications networks at a modest cost. Once established, such satellites or fiber optics networks can be easily increased in capacity over time as needed. The best educational networks are most likely to be hybrid in nature. In rural areas, VHF terrestrial radio links may feed to satellite terminals that in turn may link to fiber optic cable networks which then extend to urban production centers. The future for educational transmission connection and costs is very promising. Fiber optic cables can now be made for about $1 a foot, microterminals complete with microprocessors and printers can be

purchased for about $2000. Within the next 10 years satellite transponders may be purchased for as little as $250,000. Reduced costs will make a cornucopia of educational services available to more and more people on a global basis.

Computer Assisted Instruction

It should not be assumed that advanced telecommunications systems are the only effective means of achieving effective electronic distribution of tele-education materials. Computer Assisted Instruction (CAI), has developed into a powerful, flexible and increasingly effective tool for distance education. CAI must be considered to be a tool which in the last 20 years has evolved from a clumsy apparatus that reinforced rote memorization to a powerful educational device capable of stimulating thought, inventiveness, problem solving skills, and even artistic expression. The initial use of CAI to drill students on basic information was a limiting and one-dimensional approach to computer based education. Today thousands of education programs are commercially available on a global basis and many are of excellent quality.

This is not to say CAI is not without its problems. Since most of these systems are text based, the question of language and spelling (i.e. American vs. English) is a continuing and very real problem. Take for instance the educational program called "Poet" that was developed by the BBC for Acorn Computers. It is lively, spontaneous, and highly creative, but it is also rated as unacceptable by the American Educators because it uses "English" spelling and does not offer an optional "American" version.

There are also other areas of concern about CAI such as the lack of an intermediary, particularly teachers, to remove programming "problems", overcome cultural differences or provide local insight or knowledge. A video or radio based program can be adjusted many ways by edits, voice overs, and by clarifications in the question and answer stage. The CAI program is much more inflexible in these regards. Finally CAI is still largely a developed country phenomenon because the hardware and software are still relatively expensive. CAI costs, however, are dropping and its effectiveness improving. Nevertheless research on CAI enhancements and investigation of how it can be applied appropriately with positive effect in Third World Countries is clearly needed.

Other New Electronic Tele-Education Techniques

The innovative electronic education landscape is sprouting new ideas and products on a nearly continuous basis. Tele-education may be the most rapidly growing and dynamic activity on our planet. The field is mushrooming. Consider the following:

Intelligent Interactive Videodisc (IIV) -- There are gurus of the intelligent interactive videodisc industry who are creating automated learning systems for everything from cardiovascular pulmonary resuscitation (CPR) to orthoscopic surgery on the knee. David Hon, the President of IXION of Seattle, Washington in the U.S., has developed both systems. He started with a robotic sensory device, a dummy to simulate a human body, a microprocessor to evaluate "desired" and "undesired" actions and an interactive video disc to show in real time whether the trainee was doing the right thing or endangering the patient. Someone

learns quickly when they know in "real time" whether they are saving or killing their patient. It is interesting that these IIV devices are not only more effective in training people quickly, thoroughly and effectively as measured by final test scores, but that only the military has found sufficient resources to apply these educational training devices in any systematic way.

Artificially Intelligent Educational Toys -- Seymour Papert and Marvin Minsky of MIT have invented several educational toys, especially the computerized turtle to examine how students could learn to interact with intellectually agile robots. Students have in fact reacted quite positively to such "smart" classmates which can help solve challenging problems. Using telecommunications and video cameras, such devices can serve very large groups of students and yet preserve personalized aspects of the institution.

Tele-Robotic Controls and Remote Computer Networking -- The International Space University is planning to combine the intellectual power of students at various remote locations in order to create new computer programs, to use interactive CAD/CAM intelligent systems and even to simulate conditions in outer space. Most educational "intelligent networks" such as a 3rd or 4th generation BITNET will in the 21st century be able to operate across time and space.

The above three examples and many others reflect how dynamic and innovative the field of tele-education really is. The key point is that the various electronic and photonic technologies are tending to merge together in new and creative ways. Satellite communications are connecting to fiber optics and terrestrial radio service in order to provide data, radio and video services. Enhancing these networks are sophisticated computer programs, artificial intelligence, expert systems, CAD/CAM design

modules, interactive radio disc systems and "intelligent" robotic devices. Educators of the 21st century will have all these tools and more to rely upon in designing good and responsive programs for every need group. The great value of such tools is their flexibility. They can be reshaped for educational services to students in remote and rural areas, to urban remedial students, to workers who are being retrained for new jobs, and to graduate scholars seeking advanced degrees.

One innovation, now being implemented on a global scale, can aid tele-education to be lower in cost, be more geographically extensive and ultimately be more powerful in educational applications. This new development is called Integrated Services Digital Network (ISDN). It is essentially a global blueprint for the electronic digital highway of tomorrow. More precisely it is the new set of digital communications standards which the International Telecommunications Union plus its Consultative Committee and the International Standards Organization (ISO) have been trying to establish since the early 1970's. The ability to "open" networks with universally accessible ports at any place, at any time, could potentially be an enormous benefit in creating universal education networks. The potential of ISDN is not necessarily the reality. Care must be taken to ensure that terrestrial and satellite networks are both effectively encompassed within the ISDN standards. This is a concern because over 100 developing countries are exclusively linked to the rest of the world only by satellites while developed countries are increasingly linked by terrestrial cable. Excessively stringent ISDN standards against transmission delay could serve to limit global interconnectivity by prohibiting satellite links.

One trend is clear, however, and that is the importance of making tele-educational systems of the future digitally based. By the 21st century desk top computers will have the performance of so-called main frame computers. Furthermore artificial intelligence and expert systems will allow many routine educational functions to be automated. Whole educational systems from end to end will depend upon digital transmission, digital processing, or some other form of digital technique.

To illustrate how quickly this trend is moving, consider the artificially intelligent program developed under the funding of the British Library, a part of the British Museum. This program, known as ASK, lets a researcher interact through a keyboard to define research topics, identify areas of inquiry and even to "stumble upon" unexpected questions and issues. The process is much like interacting with a well trained and personalized librarian. Such "expert systems" will not replace teachers, teaching aides, librarians and administrators, but it will supplement these positions and leverage their effectiveness. Both because of a lack of qualified educators and the high cost of conventional education, tele-education will be increasingly used around the world.

Try to imagine running an airline in today's world without computers, word processors and advanced telecommunications networks. Then realize that in the 21st century running an educational program without electronic media, computers and tele-educational techniques would be perhaps even more difficult. It will be virtually impossible.

<u>What the 1980's Have Taught Us About Tele-Education</u>

The idea of distance education has been around for some years, largely as a means of overcoming remoteness and rural locations. These early approaches were based upon books, educational networks and correspondence. They have over many decades proven helpful and satisfactory in both formal and non-formal education and training.

With the advent of electronic media some people thought that the reality and effectiveness of the classroom could be effectively simulated. Some rather preposterous things were said about the ability to replace all teachers, to create global education better, faster and cheaper. Such predictions with unrealistic goals have subsided, and today a new and more sensible approach to tele-education is being taken. Tele-education is seen as an enhancement and a supplement to either conventional education or conventional distance education. Goals are more clearly and accurately targeted and barriers and difficulties more clearly understood. In the earlier section on New Technology and Education Today some of the results of the recent tele-educational projects were given in the form of recommendations for the effective use of this technology. This need not be repeated. Here it is important to emphasize the limitations of tele-education techniques and the strategies for coping with these problems and barriers.

National, Cultural and Language Barriers

National, political, cultural, social and language sensitivities must always be considered. The cultural content, the substantive message and the linguistic phrasing of the educational program must be considered. There are many strategies that can be used. A video program can be

designed for voice over narration and local teachers can create their own sound tracks. Productions can be cooperative efforts involving several countries or even several regions of a large country. The co-producers can then ensure that local concerns or language issues have been addressed. Whatever the approach that is taken, local input by teachers and aides is still likely to be needed to establish local relevancy and a personalized feel.

Tele-Education: Curriculum as Education Enhancement

Some people envision tele-education as putting a television set in front of a class for 6 hours a day for students to soak up 6 or 7 lectures. This is not what tele-education is today and even less so tomorrow. Years of exposure confirm the educational philosophy of using tele-education as an enhancer, as a provider of specialized knowledge, or an extra dimension that would not otherwise be available. Tele-education can seldom, if ever, attempt to be the total offering. As many enriching and educating elements as possible should be made available in the form of books, exercise materials, teachers, aides, field trips, etc. In other words the key concepts are educational enhancement and augmenting the capabilities of classroom teachers.

Focusing on the Local Environment

Some people see the key to modern tele-education being a single global educational production unit. Such a facility could produce a single comprehensive set of educational materials of high quality at low unit cost. This approach, however, tends to see education as one-way and unitary. In fact there is good evidence that it is the interaction not only between

students and teacher, but also among students that instills the value of learning. Simplicity, localism, personal interaction cannot be replaced by global expertise. If one initiates a tele-education project and there is not a vigorous and energetic attempt to have active local participation as a cooperative undertaking then its chance of success is low. Even the centralized programming should have local teacher participation.

Curriculum Does Make a Difference

All tele-education courses are not created equal. Some course are much better suited to tele-education techniques than others. Science and mathematics courses for instance can be delivered very effectively via tele-education means. This is for a number of reasons such as: (i) content varies very little from country and country in these curricula areas; (ii) linguistic nuance is little affected since technical terminology is largely international; (iii) special program material giving information on state of the art research can be especially helpful for laboratory exercises and (iv) the results of the course can be easily and objectively tested.

A course in national history or literature of course, must apply tele-educational programming much more carefully and sparingly. There is probably great merit in having a network of clearinghouses around the world to coordinate the planning, production and distribution of tele-education productions with local, regional and international production centers working together to meet everyone's needs. No one center can meet everyone's needs, but coordinated productions among many different centers could be remarkably effective, and should result in excellent

products. This incidentally is the approach endorsed by the Foundation for International Tele-Education (FIT).

Management of Tele-Education Activities

For many of the reasons noted above, tele-education activities are very difficult to manage. If one were to create one or even two global production centers for tele-education to serve to entire world, it would from a management viewpoint be highly efficient and desirable especially in terms of distribution, billing, scheduling and marketing. The trouble is that management efficiency at a highly centralized level can work counter to the educational needs of a responsive and sensitive tele-educational program. The following chart seeks to highlight the conflicting, substantiative, management and financial priorities that arise in the field of tele-education.

Table II

Key Factors	Management Need	Program Need	Financial Need
High Quality Instructional TV Production Centers	As Few as Possible	As Many as Possible at the Global, Regional and National Level.	As Few as Possible
Source of Revenues	Large Dependable Sources of Revenue, i.e. Government Grants and through sale of programs.	Diversified Sources, distributed around the world and not dependant upon one or a few sources.	Secure long term commitments
Programming Diversity	Focus on TV; Major Languages and basic curriculum. Sale of programs to maximize revenues (Limit narrow band services, exotic languages, etc)	Provide diversity of wideband and narrow band programming. Lease and lending of programs. Seek cultural and linguistic diversity. Encourage Co and Multiple Productions.	Keep inventory of programming to a minimum. Use voice-over on single production to create global programming. Keep capital investment and staffing to minimum

Transmission Systems	Low Cost. Large Scale networks with Global or Regional coverage	Personalized smaller scale networks with a very high degree of interconnectivity.	Tight control of use of networks Use of latest & most cost efficient technology. Clear auditing capability.
Management Characteristics	Single streamlined management structure with heirarchical lines of communications.	Decentralized structure with local autonomy and quick ability to initiate or revise programming.	Veto power on all financial expenditures at the top.

Table II clearly highlights the degree to which management and financial considerations could or would run counter to the needs of a decentralized and locally focused programming approach to producing tele-education. It is felt that the approach of the Foundation for International Tele-Education of creating clearinghouses for "coordinating" the production of electronic programming is the best means of bridging this problem. The clearinghouses would seek to find linkages and in effect to "marry" existing local and national centers to create regional productions as opposed to trying to get local units to accept what regional or global units have already produced. In time, the clearinghouse would probably play a matchmaker role at the local, regional and even global role. It is, however, a clear fact of life that available financial resources will ultimately decide the ultimate balance in management and control of international tele-education.

Conclusions

The current state of the field of tele-education is probably best described as pre-adolescence. The experimentation and limited capabilities of childhood are just beginning to be left behind and the promise of

exciting future capabilities are just beginning to be recognized. The possibility remains of being caught up in senseless disputes and destructive bickering as to where to go next, who leads and who follows, and whose goals and ambitions should take precedence.

At this conference we have a remarkable opportunity to achieve a new maturity and to climb to new heights in international cooperation. Tele-education and electronic institutions are capable of remarkable feats. We now know we can teach over 100,000 doctors the latest techniques in dealing with infant diarrhea. We now know we can teach 1 million Chinese students in subjects ranging from differential equations or how to set a broken leg. We now know we have powerful tools that can change our world. Tele-education is not a perfect technique, but it does hold out a new hope for humanity -- a humanity that will reach 8 to 10 billion by the middle of the 21st century. The key will be to use tele-education to actually educate massive numbers of people but not engage in megatraining. It is because the Foundation for International Tele-Education (FIT) favors global diversity in "mediated learning" that its goal is to create a network of tele-education programming centers around the world rather than a single unit.

It is not enough merely to catalogue all of the difficulties and sensitivities that tele-education must address. We must examine, evaluate and use, where appropriate, the many new transmission and programming capabilities that are now available from advanced communications satellites to "intelligent interactive videodisc". Surprisingly, the key to making international tele-education work is very simple. Effective coordination and humanistic cooperation can realize the potential of this remarkable technology. The many organizations who have already joined in the effort

to create the Foundation for International Tele-Education have taken the important first steps to build an effective coordination of education, linguistic, telecommunications and government administrators needed to lift tele-education from infancy and adolescence to its next level of development -- young adulthood. With your help and the help of your friends we should see tele-education come into its own in the 1990's -- the stage of responsible global citizenship with dozens of tele-education centers spanning the globe.